EPA's SF_6 EMISSIONS REDUCTION PARTNERSHIP FOR ELECTRIC POWER SYSTEMS: PROGRESS AND ACCOMPLISHMENTS, 1999-2001

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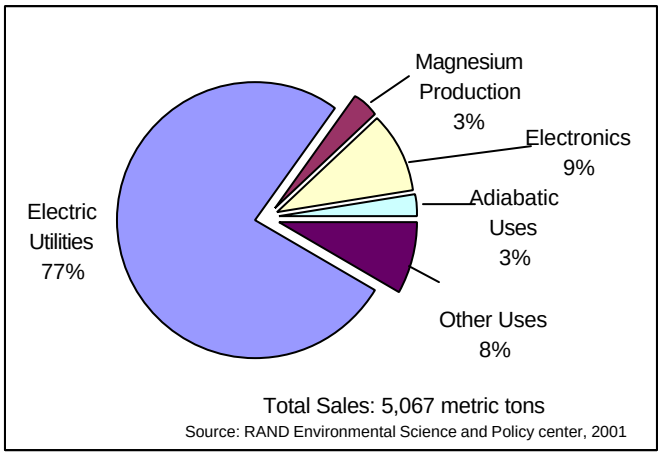
1 INTRODUCTION

Many companies are evaluating their impact on the environment and then acting to change for the better. A number of partnership opportunities exist for businesses and organizations to enhance investment in attractive, yet underutilized, technologies and practices that reduce greenhouse gas emissions. The SF_6 Emissions Reduction Partnership is one such opportunity sponsored by the US Environmental Protection Agency (EPA).

1.1 What is SF_6?

Sulfur hexafluoride (SF_6) is a gaseous dielectric used by the electric industry in high-voltage circuit breakers, gas-insulated substations, and other switchgear. Enclosed in electrical power equipment, it is an effective gas that allows for the safe transmission of high voltage electricity. SF_6 is 100 times better than air in interrupting electrical arcs. While SF_6 is inert during normal use, when electrical discharges occur within SF_6-filled switching equipment, toxic byproducts can be produced.

As illustrated in Figure I, most SF_6 produced (roughly 80 percent) is used for electric power system equipment. SF_6 circuit breakers have come to completely dominate the high voltage circuit breaker market and in the process have made obsolete the air blast and oil technologies. According to Ruben Garzon, SF_6 circuit breakers are used in almost all applications involving system voltages from 72.5 kV to 800 kV (1).



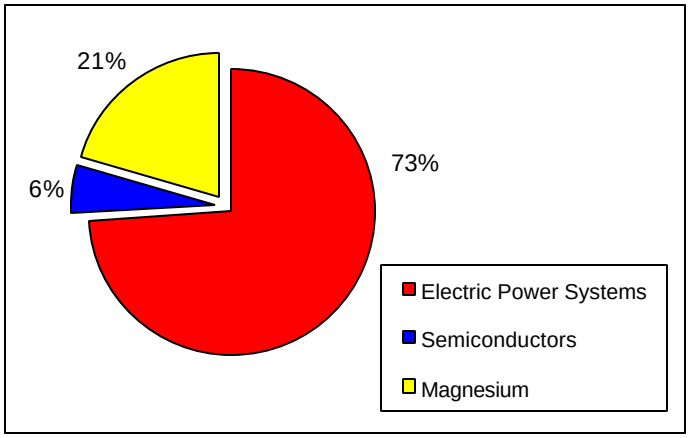
1999 Worldwide Sales of SF_6
FIGURE I

SF_6 has also been identified by scientists from the Intergovernmental Panel on Climate Change (IPCC) as a gas that contributes to climate change. According to the IPCC, SF_6 is 23,900 times more effective at trapping infrared radiation than an equivalent amount of carbon dioxide (CO_2). For this reason the EPA has developed a voluntary partnership with members of the electric power industry to share information, encourage better management practices, and reduce SF_6 gas emissions.

1.2 Climate Impact of SF_6

While emitted in smaller quantities than other greenhouse gases, SF_6 is important to address due to its greater impact per molecule in trapping heat and its long atmospheric life. The potential threat from SF_6 to our climate is great since 1 pound of SF_6 released is roughly equivalent to thermal warming of 11 tons of CO_2. This combined with an atmospheric life of 3,200 years makes SF_6 one of the most potent greenhouse gases. Figure II presents the

relative contribution of the three primary U.S. sources of SF_6 emissions. In 2000, approximately 73 percent of U.S. sources of SF_6 emissions came from the electric power industry (2).

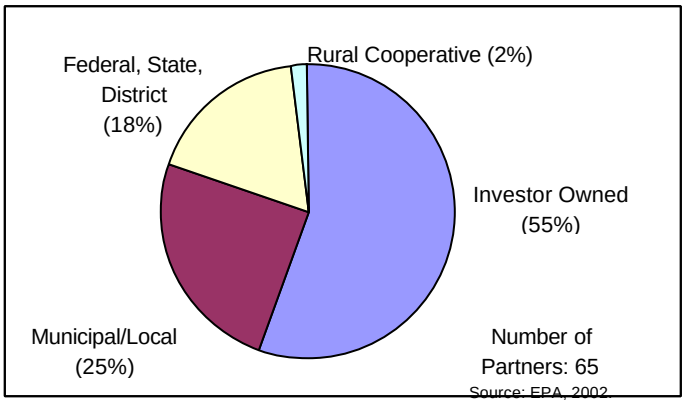


Relative Contribution of SF_6 from U.S. Electric Power Systems – 2000 (2)
FIGURE II

1.3 SF_6 Emissions Reduction Partnership for Electric Power Systems

Although SF_6 is critical to the transmission infrastructure of electrical power, many utilities recognize the importance of careful management and responsible use of the gas. Currently, 65 utilities have joined EPA's voluntary program: The SF_6 Emissions Reduction Partnership for Electric Power Systems. A list of these participating companies is detailed in Addendum A. Figure III provides a profile of the partnership by ownership type.

Electric power partners pursue technically feasible and economically sound actions that minimize SF_6 emissions and while reducing the threat of climate change. SF_6 partners benchmark their historic SF_6 emissions, set an aggressive emissions reduction goal, develop a corporate policy for managing SF_6, and report their annual progress toward their goal.



Profile of Partner Utilities by Ownership
FIGURE III

2 PARTNERSHIP ACCOMPLISHMENTS

Between 1999 and 2001, cumulative SF_6 emissions reductions from the electric utility industry were approximately 2.2 million metric tonnes of carbon dioxide equivalent (MMTCO2e). These reductions are attributable to the efforts undertaken by partner utilities, and illustrate the success of these companies in improving their gas management and handling practices. In terms of SF_6, these reductions account for approximately 202,000

lbs of SF_6. With a cost range for gas of $6.00 to $9.00 per pound, this reduction represents a financial benefit ranging between $1.2 to $1.8 million dollars during this time period. The potential environmental value of this emissions reduction is even more impressive. It is equivalent to removing the CO_2 pollution of approximately 429,000 cars.

TABLE I

Summary of Partnership SF_6 Emissions Reductions (3)

	SF6 Emissions ($MMTCO_2e$)	Reduction from Baseline ($MMTCO_2e$)
1999 (baseline)	15.78	?
2000	14.74	1.04 (6.7 %)
2001	14.63	1.15 (7.3 %)

3. PARTNER CASE STUDIES AND OBSERVATIONS

3.1 Bonneville Power Administration

As a partner in the SF_6 Emissions Reductions Partnership, Bonneville Power Administration (BPA) has demonstrated its concern for the environment while continuing their mission of providing energy to customers. BPA has been able to save money and simultaneously help address global climate change through their SF_6 management strategy.

The SF_6 management program is tied directly to their maintenance program. SF_6 monitoring is part of the regularly scheduled maintenance and inspection protocol. When operational commitments permit, BPA Substation Maintenance crews will take leaking equipment out of service, evacuate gas, put the vessel under vacuum, and perform leak tests to diagnose and make repairs. By closely monitoring SF_6 usage through their network tracking program, BPA is able to identify those equipment that are losing large amounts of SF_6. These maintenance and repair operations on existing equipment have reduced leaks by 585 lbs. In 2001, BPA was able to reduce SF_6 loss by repair and replacement of leaking equipment by 2,765 lbs. A conservative estimate of the price of SF_6 is approximately $9 per lb. This calculates to an SF_6 gas savings of approximately $25,000 in 2001 alone.

In addition to the replacement of existing electrical equipment with models that offer lower tolerances in manufacturer listed leak rates, BPA progressively upgrades their gas handling carts and equipment. These upgrades include moving to self sealing hoses and improving the integrity of gas transfer storage and handling systems.

3.2 Consolidated Edison

As a dedicated partner in the SF_6 Emissions Reductions Partnership, Con Edison is committed to taking a leadership role in working with the EPA to develop better ways to protect the environment from SF_6 gas. The company is emerging as an environmental leader in the industry while also experiencing financial savings through the implementation of an aggressive SF_6 management program. These efforts have resulted in an estimated reduction in SF_6 usage by 500 cylinders or 57,500 pounds; the utility has realized a savings of $517,500 per year, where the cost of the gas is assumed to be $9 per pound.

Con Edison has set a goal of reducing SF_6 emissions annually by using five percent fewer SF_6 cylinders than were used in 1996 (their baseline year). By 2001, the utility met and greatly exceeded their goal by reducing SF_6 emissions by approximately 29 percent since 1996. Con Edison explains that the most valuable effort in reaching this goal has been through the establishment of an aggressive plan on how to manage SF_6 gas. The company has clearly demonstrated that a proactive approach to reducing SF_6 emissions to the atmosphere is feasible and effective, and that such an approach provides benefits for both the company and the environment at large.

3.3 Equipment Observations

With the increasing use of SF_6 inventory tracking systems, Partners are capable of identifying specific SF_6-containing equipment that requires excessive refilling operations. Increased SF_6 consumption may indicate mechanical or structural problems, leading to potential equipment failure. Table II provides a summary of Partner-reported information relating to specific pieces of equipment that have required excessive gas additions over an

annual period. Please note that this information should not be used to highlight problems with specific equipment types and brands, but are merely an indication of partner-reported experiences with individual pieces of equipment.

TABLE II
Summary of Partner-Reported SF_6 Gas Filling Experiences[a]

Equipment	Manufacturer	Type	Name-Plate Capacity (lbs)	Annual Gas Addition (lbs)	Leak Rate (%)
Circuit Breaker	Westinghouse	5000-SFA-38000 - 500 kV	1500	312	21%
Circuit Breaker	Westinghouse	5000-SFA-38000 - 500 kV	1500	225	15%
Circuit Breaker	Westinghouse	2300-SF-20000 - 230 kV	800	117	15%
Circuit Breaker	Heliotrope General	HVB-242-63000 - 242 kV	450	70	16%
Current Transformer	General Electric	BM - 250 kV	250	175	70%
Circuit Breaker	Westinghouse	550 LWEC - 500 kV	192	22	11%
Current Transformer	Trench	HGF 1800 - 500 kV	130	35	27%
Current Transformer	Trench	HGF 1800 - 500 kV	130	34	26%
Circuit Breaker	Westinghouse	362LWER50	110	42.3	38%
Circuit Breaker	Cogenel	FX-32 - 550 kV	89	30	34%
Circuit Breaker	ABB	ELF SP7-2 - 550 kV	70	46.5	66%
Circuit Breaker	ABB	ELF SP7-2 - 550 kV	70	20	29%
Circuit Breaker	ABB	72 PM - 72.5 kV	21	15	71%
Circuit Breaker	Siemens	SP-38-23-3	15	10.9	73%
Circuit Breaker	Siemens	SP-38-23-3	15	6.8	45%
Circuit Breaker	Siemens	SP-38-23-3	15	4.1	27%

[a]While the information highlights those specific individual circuit breakers and current transformers that required significant SF6 re-filling during the reporting period, partners have not provided any specific reasons for these actions.

4. CONCLUSION

By reporting data to EPA, SF_6 partners create a lasting record of their accomplishments through an EPA-approved emissions protocol. Partners also identify themselves as corporate environmental leaders and strategically position themselves as climate change policy continues to unfold.

Voluntary partnership programs will continue to be a powerful means for reducing greenhouse gas emissions, while saving businesses money**.**

REFERENCES

1. Garzon, R., High Voltage Circuit Breakers Design and Applications, Marcel Dekker Inc., 1997.

2. U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2000; EPA 430-R-02-003, 2002.

3. U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001; 2003. Draft Document.

ADDENDUM A: EXISTING PARTNERS AS OF MARCH, 2003

The SF_6 Emissions Reduction Partnership for Electric Power Systems currently consists of 65 electric utility companies:

Allegheny Power (Greensburg, PA)
American Electric Power (Columbus, OH)
Athens Electric Department (Athens, AL)
Austin Energy (Austin, TX)
Bangor Hydro-Electric Company (Bangor, ME)
Big Rivers Electric Corporation (Henderson, KY)
Bonneville Power Administration (Portland, OR)
Central Maine Power Company (Augusta, ME)
Central Vermont Public Service Corporation (Rutland, VT)
Cinergy Power Generation Services Inc., (on behalf of The Cincinnati Gas & Electric Company and PSI Energy, Inc.), (Cincinnati, OH)
City of Monroe (Monroe, NC)
Columbia River People's Utility District (St. Helens, OR)
Commonwealth Edison (Chicago, IL)
Commonwealth Electric (Wareham, MA)
Connecticut Light and Power Company (Northeast Utilities) (Berlin, CT)
Consolidated Edison Company of New York, Inc. (New York, NY)
Crisp County Power Commission (Cordele, GA)
Duquesne Light Company (Pittsburgh, PA)
Edison International (Rosemead, CA)
El Paso Electric Company (El Paso, TX)
Eugene Water & Electric Board (Eugene, OR)
FirstEnergy Corporation (Akron, OH)
Florida Power & Light Company (Juno Beach, FL)
Fort Pierce Utilities Authority (Fort Pierce, FL)
GPU Energy (Reading, PA)
Grand Island Utilities Department (Grand Island, NE)
Hastings Utilities (Hastings, NE)
Kings River Conservation District (Fresno, CA)
Lower Colorado River Authority (Austin, TX)
Maine Public Service Company (Presque Isle, ME)
Manitowoc Public Utilities (Manitowoc, WI)
Memphis Light, Gas & Water Division (Memphis, TN)
Menasha Electric and Water Utilities (Menasha, WI)
Montana Power Company (Butte, MT)
Muscatine Power & Water (Muscatine, IA)
Nashville Electric Service (Nashville, TN)
Nebraska Public Power District (Doniphan, NE)
New York Power Authority (New York, NY)
Niagara Mohawk Power Corp (Syracuse, NY)
North Atlantic Energy Service Corporation (Seabrook, NH)
Northeast Utilities Services Company (Hartford, CT)
Northern Indiana Public Service Company (NIPSCO) (Merriville, IN)
Oklahoma Gas and Electric Co (OG&E) (Oklahoma City, OK)
Pacific Gas and Electric Co (San Francisco, CA)
Paragould City Light & Water (Paragould, AR)
Public Utility District No. 1 of Douglas County (East Wenatchee, WA)
Public Utility District No. 1 of Pend Oreille County (Newport, WA)
Public Service Company of New Hampshire (Northeast Utilities) (Manchester, CT)
Reliant Energy HL & P (Houston, TX)
Rochester Gas and Electric Corp (Rochester, NY)
Salt River Project Power District (Phoenix, AZ)

San Antonio City Public Service Board (San Antonio, TX)
Silicon Valley Power (Santa Clara, CA)
South Carolina Electric & Gas Company (Columbia, SC)
Southern Company (Atlanta, GA)
Southwestern Electric Power Company (Shreveport, LA)
Tennessee Valley Authority (Knoxville, TN)
Texas Municipal Power Agency (Bryan, TX)
Oncur (formerly TXU) (Dallas, TX)
Village of Prairie du Sac (Prairie du Sac, WI)
Wallingford Electric Division (Wallingford, CT)
Wellton-Mohawk Irrigation & Drainage Dist (Wellton, AZ)
West Texas Utilities Co (Abilene, TX)
Western Massachusetts Electric Company (Northeast Utilities) (West Springfield, MA)
Wisconsin Electric Power Co (Milwaukee, WI)